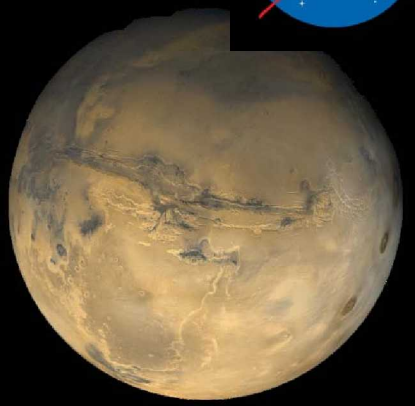
National Aeronautics and Space Administration



Overview of Human Factors and Habitability at NASA

Janis Connolly, M. Arch and Mary Kaiser, PhD

Project Manager /Project Scientist

Space Human Factors Engineering Project

Human Research Program

Focus of Human Factors and Habitability

How can equipment, spacecraft design, tools, procedures, and even nutrition be used to improve the health, safety, and efficiency of crewmembers? Can variables such as work scheduling, sleep cycles, leisure time, and communication be modified to improve team performance in the space environment?

These are the kinds of questions addressed by researchers in the Human Factors and Habitability program. Taking into consideration the unique challenges posed by the space environment, HRP scientists and engineers, along with other experts, focus on refining every aspect of a crew member's equipment, gear, food, and interior environments in order to improve safety and maximize performance.

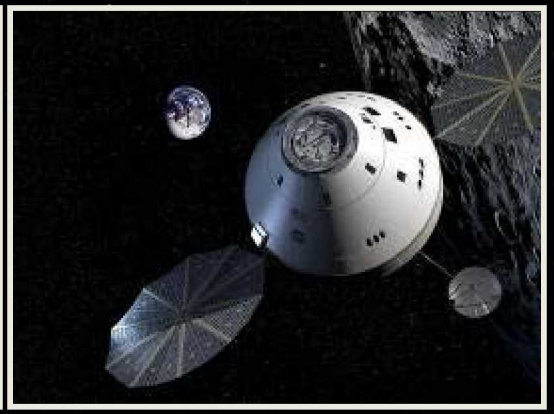
As future missions take crewmembers deeper into space and require longer stays in the space environment, the HRP's human factors and habitability research will move towards addressing the challenges of long-term space travel and habitation.
Future space missions are likely to uncover many new issues and areas of study for HRP researchers and engineers.

Components of the Constellation Program

The Constellation Program is comprised of 7 Projects

Ares – Launch Vehicles

Orion – Crew Exploration Vehicle



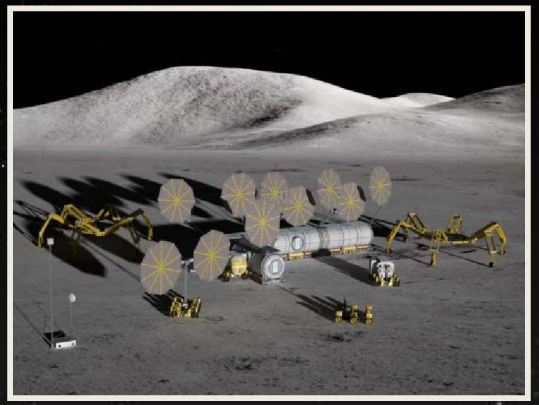
Extravehicular Activities

Mission Operations

Ground Operations

Altair

Lunar Surface Systems



Orion Crew Module

Transport 4 crew on Orion for crew rotation

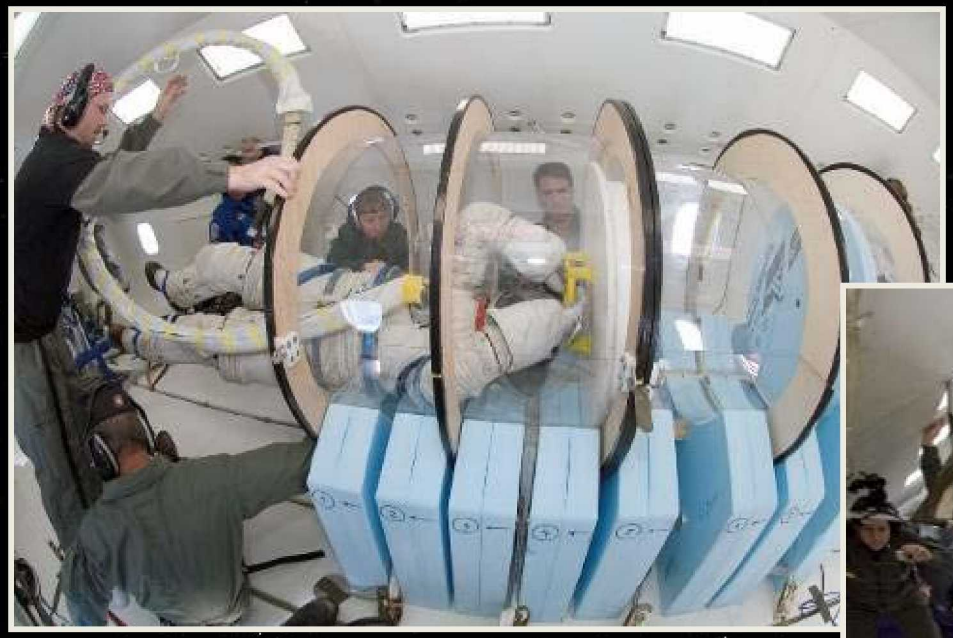
Emergency lifeboat for ISS crew

Deliver pressurized cargo for ISS resupply

Orion Crew Module – Configuration and Development

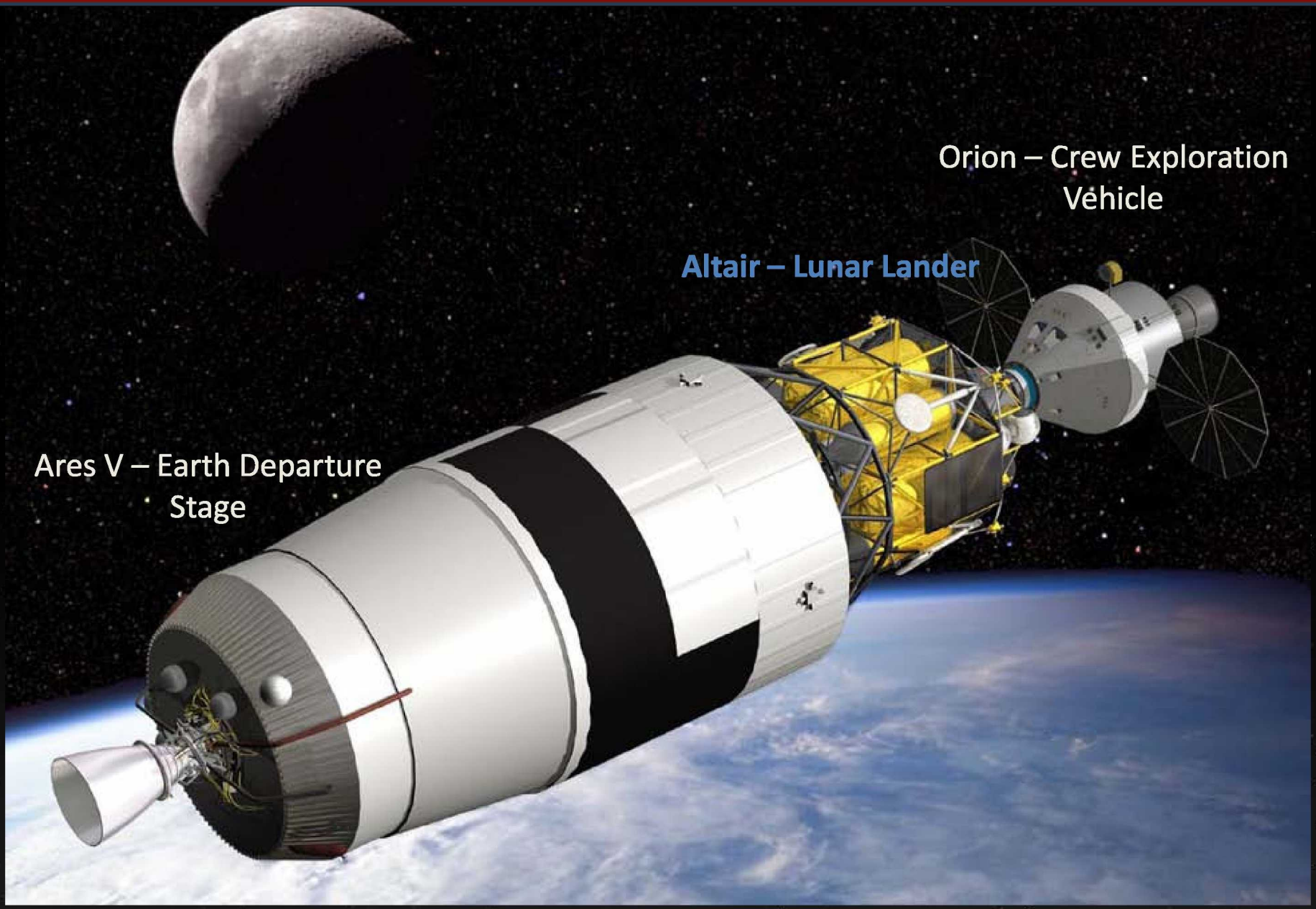
Internal layout of crew functional areas
Seat layout
Acoustic/noise modeling
Displays and controls design
Usability of the environment
Hatch design development/dimension

Orion Translation and Hatch Development

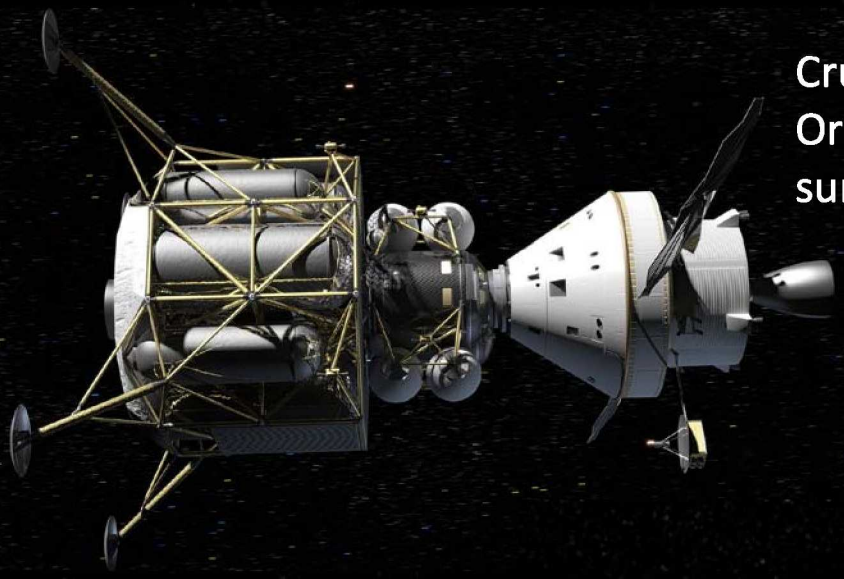


Orion hatch and
tunnel ingress/egress

The Lunar Lander - Altair



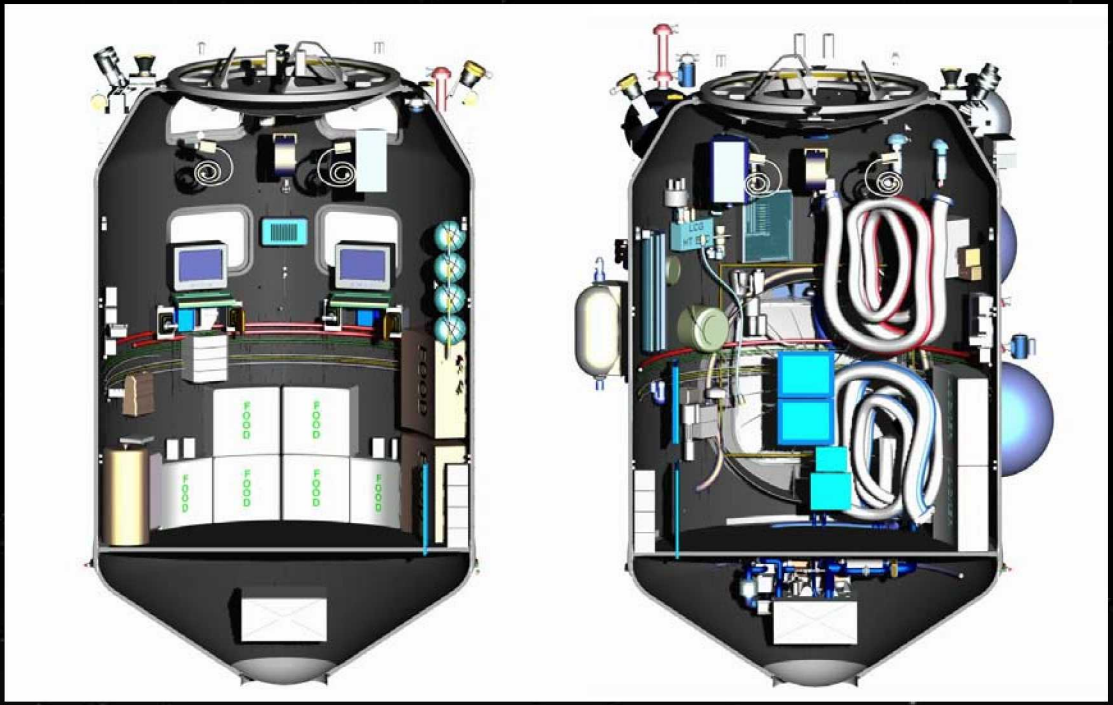
The Lunar Lander - Altair

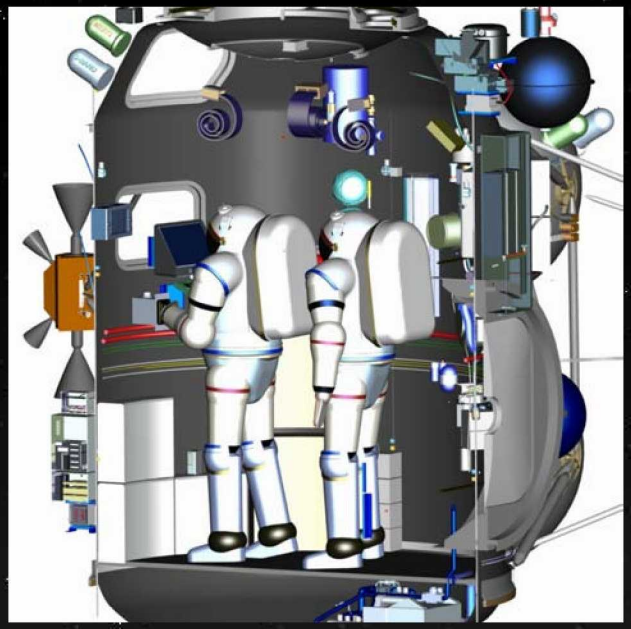


Cruise configuration to the Moon
Orion will orbit while lander descends to the surface

Lander descent stage remains and ascent stage rejoins with Orion

The Lunar Lander - Altair





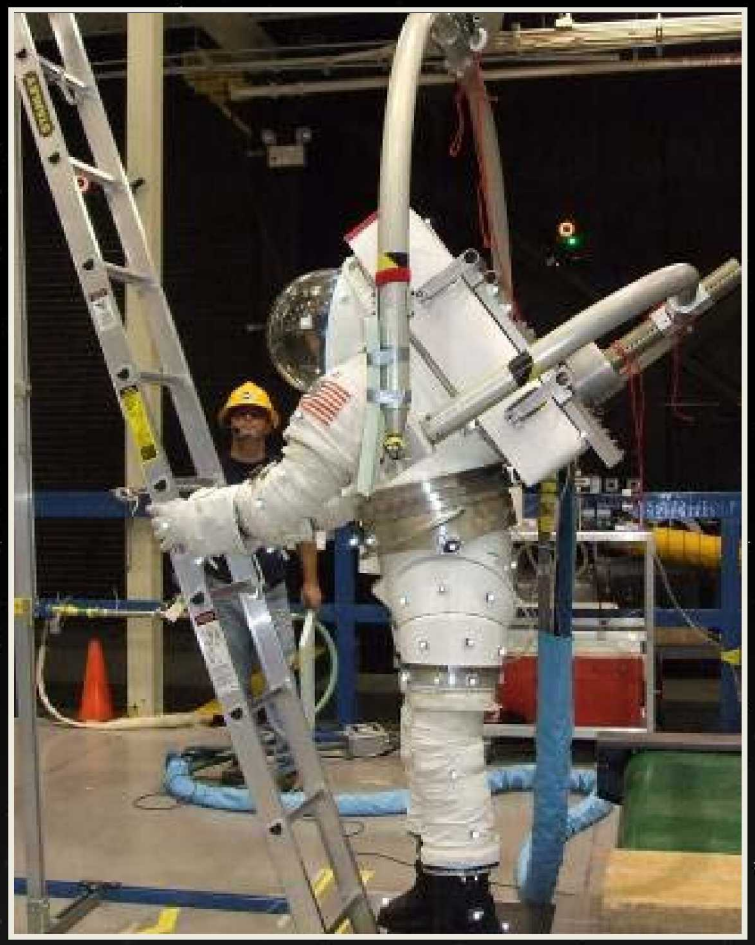
Internal configuration concepts

Altair – Interior Configuration for 4 Crew

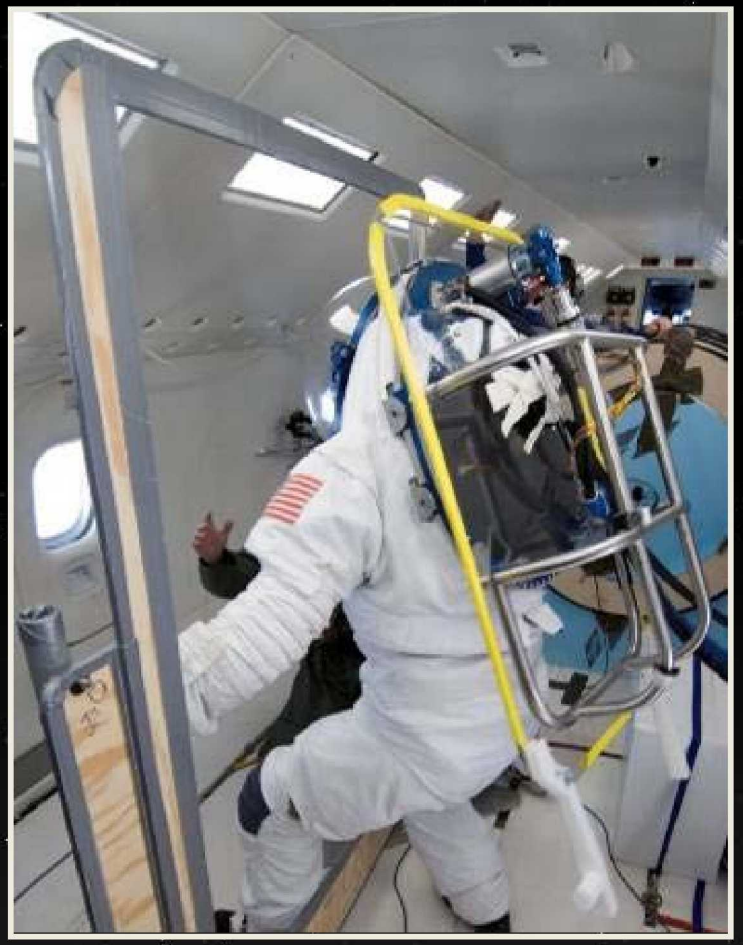
Internal configuration concepts

Altair Conceptual Development and Evaluation

Mark III Suit ladder test

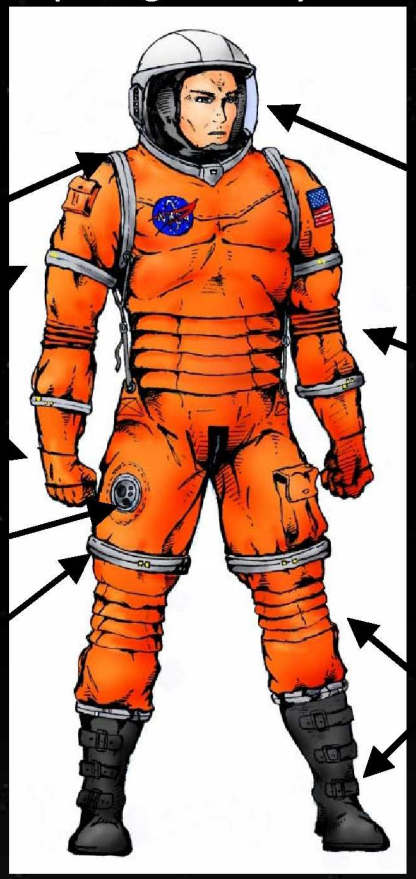


Altair hatch ingress/egress



Designing for Extra-Vehicular Activity
Anthropometrics and Biomechanics

LEA/Microgravity EVA Suit
(Configuration 1)



Arm disconnect for modularity

Hip Bearing

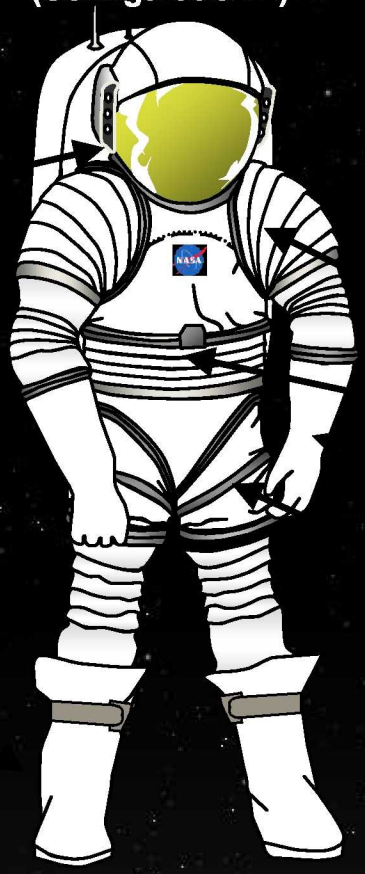
Thigh disconnect for modularity

Common helmet

Common lower arms

Common legs/boots

Lunar Surface EVA Suit
(Configuration 2)



PLSS (8 Hr EVA)

Enhanced mobility shoulder

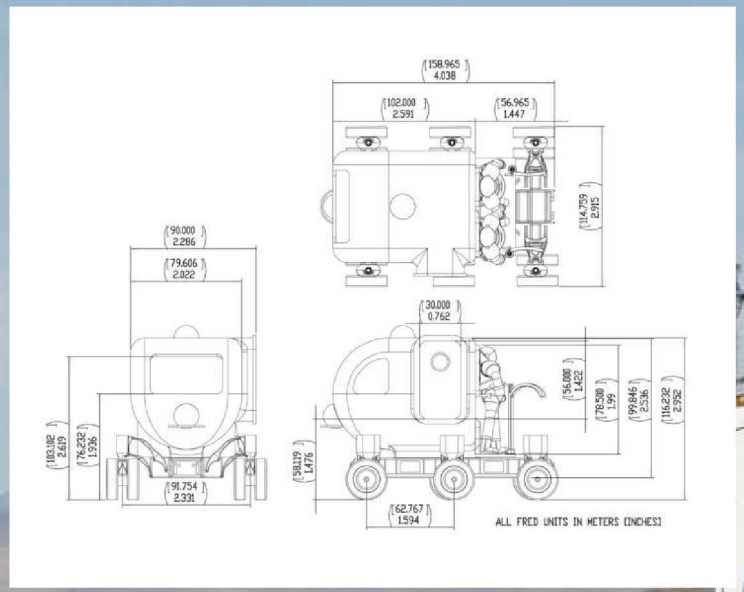
EVA Gloves

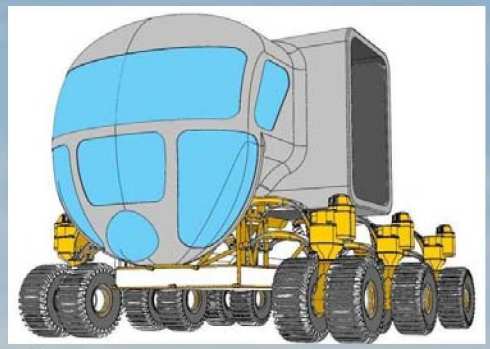
Multi-hip Bearing

TMG/MLI for relevant environment

Overall EVA System architecture approach provides a modular, reconfigurable, component-based, lower mass architecture, that meets various mission objectives

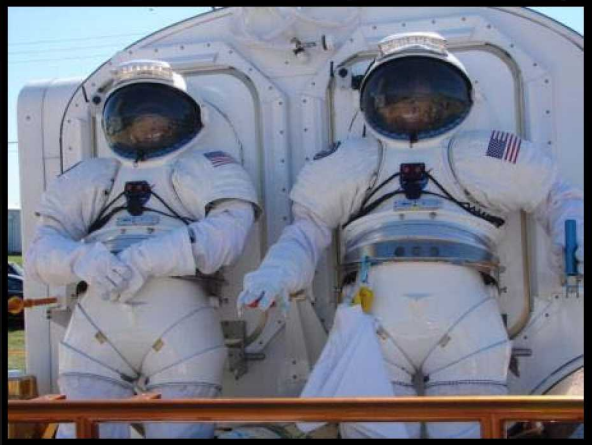
Lunar Electric Rover Design Development





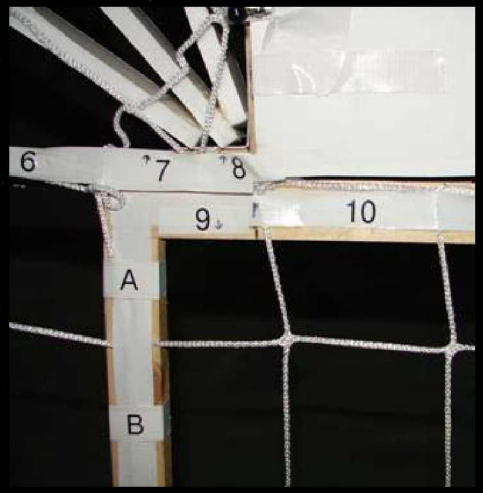
LER Conceptual Design and Field Evaluations

Concept mockups and low-fidelity models
Concepts fabricated to take to field testing



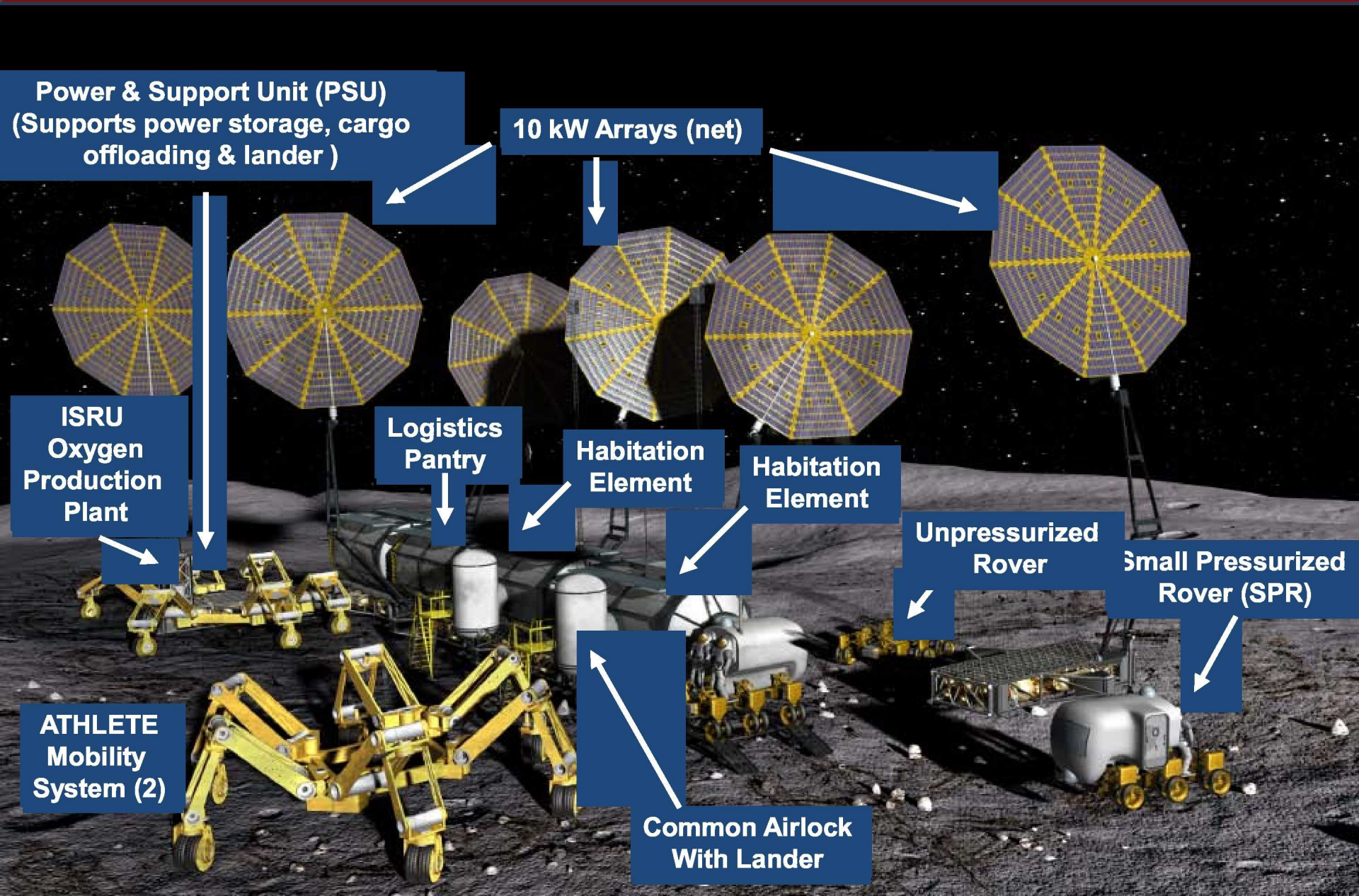
Lunar Electric Rover Window Conceptual Design

Concept mockups and low-fidelity models
For visual capability determination and window design/placement

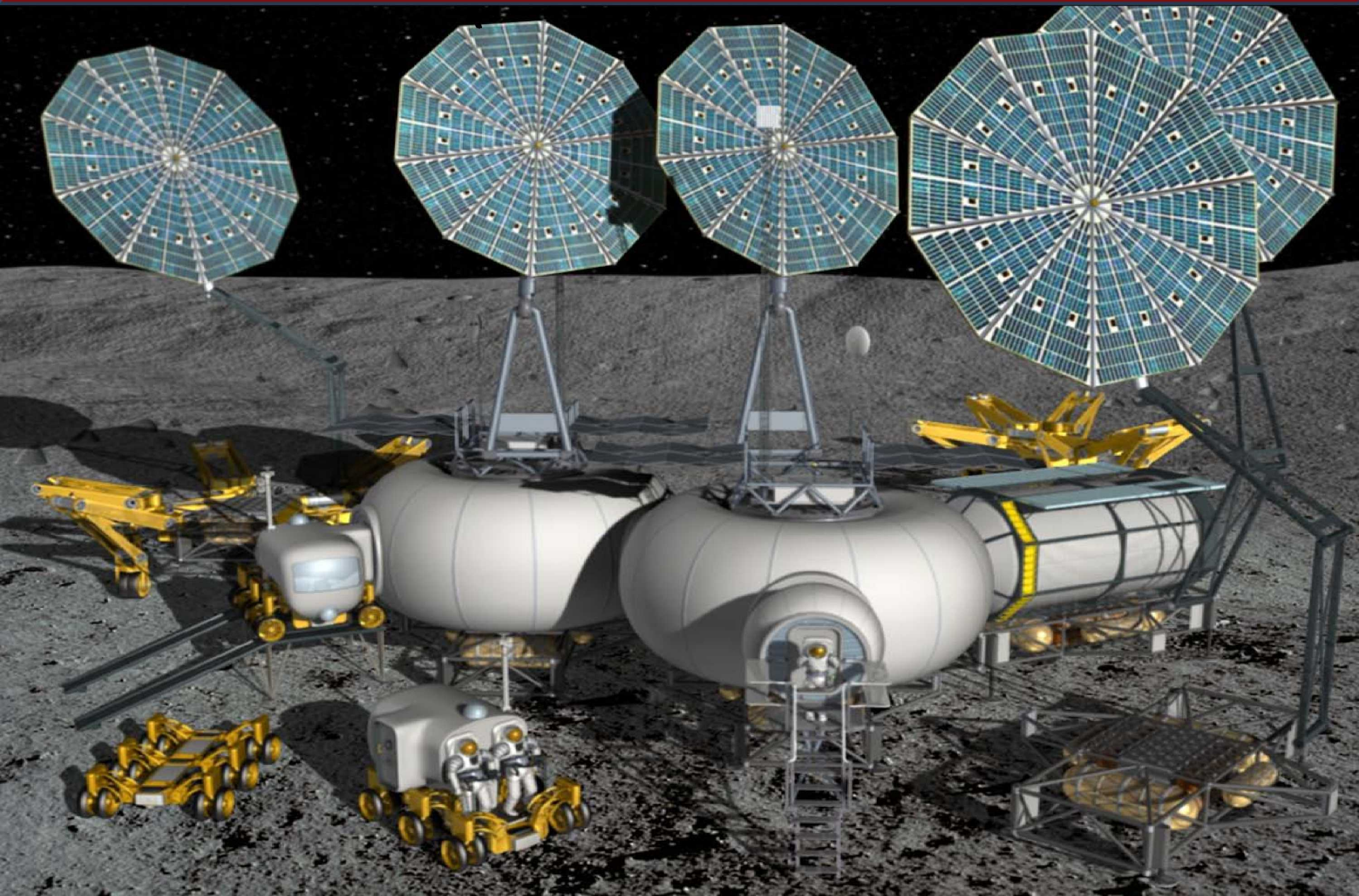


The Lunar Electric Rover

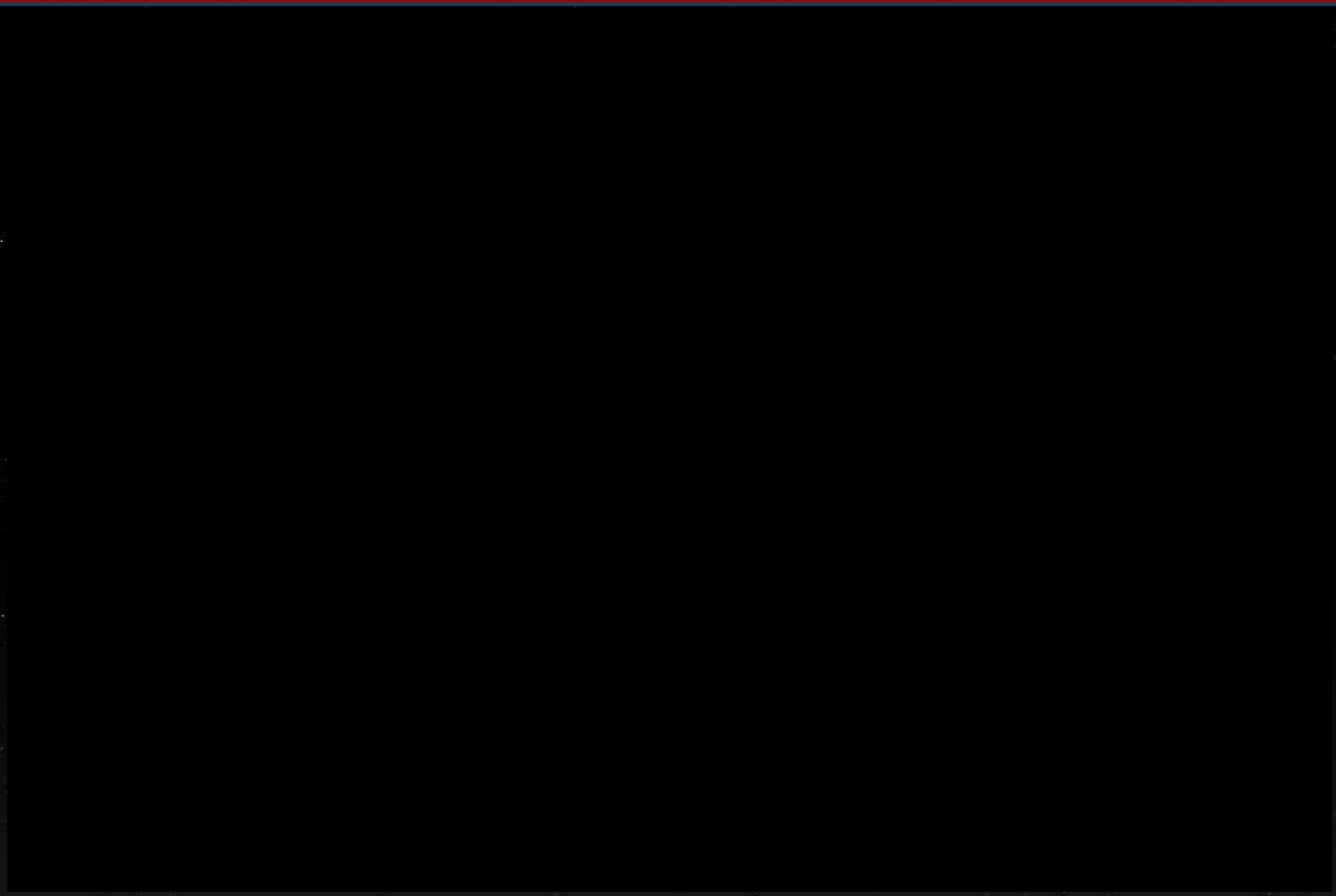
Lunar Surface System Infrastructure



Lunar Surface System Infrastructure
Inflatable Technology Concepts



Family Portrait of Us……*All* of Us



Kaguya Spacecraft 2008 – 1st high definition TV camera
First Japanese lunar mission

"We leave as we came and, God willing, as we shall return, with peace and hope for all mankind."

Eugene Cernan,
Commander of the last Apollo Mission